

REMARKS/ARGUMENTS

Favorable reconsideration of this application in light of the following discussion is respectfully requested.

Claims 1-13 and 21-32 are pending in the present application. Claims 1-13 and 21-32 are maintained by the present amendment.

In the outstanding Office Action, Claims 1-11 and 21-32 were rejected under 35 U.S.C. § 103(a) as obvious over Takahashi (U.S. Patent No. 5,960,264) in view of Majumdar et al. (U.S. Patent No. 5,623,152, herein "Majumdar"); Claim 12 was rejected under 35 U.S.C. § 103(a) as obvious over Takahashi in view of Majumdar and Uenishi et al. (U.S. Patent No. 5,894,149, herein "Uenishi"); Claim 13 was rejected under 35 U.S.C. § 103(a) as obvious over Takahashi in view of Majumdar and Takahashi (U.S. Patent No. 6,001,678, herein "Takahashi '678"); and Claim 32 was rejected under 35 U.S.C. § 103(a) as obvious over Takahashi in view of Majumdar and Takahashi (U.S. Patent No. 5,864,159, herein "Takahashi '159").

Applicant thanks the Examiner for the courtesy of an interview extended to Applicant's representative on November 20, 2003. During the interview differences between the pending claims and the applied art were discussed. The Examiner indicated that she would further review the claims and the arguments in view of a filed response and an updated search. Arguments presented during the interview are reiterated below.

Applicant notes that formal drawings including the corrections approved by the Examiner were filed on June 6, 2003.

Claims 1-11 and 21-32 were rejected under 35 U.S.C. § 103(a) as obvious over Takahashi in view of Majumdar. That rejection is respectfully traversed.

Briefly recapitulating, independent Claim 1 is directed to a semiconductor device having various semiconductor layers, and at least one first trench and at least one second trench. A first material serving as a control electrode is buried in the at least one first trench, and a second material is formed in the at least one second trench and is not a control electrode. A first main electrode is electrically connected to the second material formed in the at least one second trench.

In a non-limiting example, Figure 1 shows the at least one first trench 7 and the at least one second trench 11, the first material 9 serving as the control electrode buried in the at least one first trench 7, the second material 15 not being a control electrode and formed in the at least one second trench 11, and the first main electrode 12 electrically connected to the second material 15.

The previously filed amendments presented remarks that the claimed semiconductor device advantageously decreases an ON-voltage, maintains a breakdown voltage, and reduces a gate capacity of the semiconductor device by providing the at least one second trench with a second material that is not a control electrode.¹

Turning now to the applied art, Takahashi shows in Figure 3 an insulating gate semiconductor having a control electrode 49 formed in each trench 53. Further, the outstanding Office Action recognizes at page 3, lines 21-23, that Takahashi “fails to disclose ... a second material formed in said at least one second trench, the second material not being a control electrode.” Further, Takahashi shows in Figure 3 that a main electrode 51 *is not electrically connected* to the control electrode 49 formed in trench 53. Therefore, as discussed during the interview, Takahashi also does not teach or suggest a first main

¹ Specification, page 23, lines 4-21.

electrode electrically connected to a second material formed in at least one second trench, as required in Claim 1.

The outstanding Office Action relies on Majumdar for teaching that a second material formed in at least one second trench is not a control electrode. Majumdar shows in Figure 13 a dielectric material 41 formed at a bottom of a trench 65, and a part of a source electrode 64 formed inside the trench 65 over the dielectric material 41.² Further, the outstanding Office Action states that it would be obvious for one of ordinary skill in the art to modify the control electrode 49 in Takahashi to include the dielectric material 41 of Majumdar that is not a control electrode.

As discussed during the interview, the dielectric material 41 in Majumdar is formed in the trench 65 between a *source control electrode* 64 and a drain control electrode 66, and a *gate control electrode* 38 is formed in a different trench 36. In addition, Majumdar discloses at column 10, line 29, to column 12, line 9, that the purpose of adding the dielectric material 41 between the source control electrode 64 and the drain control electrode 66 is to decrease “a transient voltage having a great rising edge ... applied between the drain and source.”³ In other words, the dielectric material 41 is added in Majumdar between the drain and source control electrodes because large voltages are applied across the drain and source control electrodes and the dielectric material 41 forms a capacitor that decreases the transient voltage. However, Majumdar does not teach or suggest forming the dielectric material 41 between the gate control electrode and a source/drain electrode because no voltages are applied between these control electrodes.

In addition, Majumdar does not disclose a layer that corresponds to the claimed N-type semiconductor layer 4. Accordingly, Majumdar has a problem that an ON-state voltage

² Majumdar, column 5, lines 38-58.

³ Id., column 11, lines 54-56.

is increased. On the contrary, the claimed device provides the N-type semiconductor layer 4 in responding to the problem of the increased ON-state voltage resulting from the formation of the second trench, thereby avoiding the increase of the ON-state voltage.

Therefore, it is respectfully submitted that one of ordinary skill in the art would not modify a *gate control electrode* by adding a dielectric material because that dielectric material will in effect weaken a control of the gate control electrode. Also, it is respectfully submitted that there is no motivation or suggestion on record to modify a *gate control electrode* similar to a *source control electrode* as suggested in the outstanding Office Action because their respective voltages and purposes are different.

However, as discussed during the interview, assuming *arguendo* that one of ordinary skill in the art would modify the gate control electrode in Takahashi similar to the source control electrode in Majumdar, the combination of Takahashi and Majumdar does not teach or suggest that the dielectric material 41 of Majumdar placed in the trench 53 of Takahashi is electrically connected to the main emitter electrode 51 in Takahashi, as required in independent Claim 1. To the contrary, Takahashi shows in Figure 3 that each trench 53 is defined by electrically insulating layers 48 and 50 and an inside of each trench 53 is electrically insulated from the main emitter electrode 51 of the semiconductor device.

Accordingly, it is respectfully submitted that independent Claim 1 and each of the claims depending therefrom patentably distinguish over Takahashi and Majumdar.

Claim 12 was rejected under 35 U.S.C. § 103(a) as obvious over Takahashi in view of Majumdar and Uenishi. That rejection is respectfully traversed.

The outstanding Office Action relies on Uenishi for disclosing an electrode formed on a conductive region. However, Uenishi does not overcome the deficiencies of Takahashi and Majumdar discussed above. In addition, dependent Claim 12 depends on independent Claim

1, which is believed to be allowable as noted above. Accordingly, it is respectfully submitted that dependent Claim 12 is also allowable.

Claim 13 was rejected under 35 U.S.C. § 103(a) as obvious over Takahashi in view of Majumdar and Takahashi '678. That rejection is respectfully traversed.

The outstanding Office Action relies on Takahashi '678 for disclosing a sixth layer of a second conductivity type. However, Takahashi '678 does not overcome the deficiencies of Takahashi and Majumdar discussed above. In addition, Claim 13 depends on independent Claim 1, which is believed to be allowable as discussed above. Accordingly, it is respectfully submitted that dependent Claim 13 is also allowable.

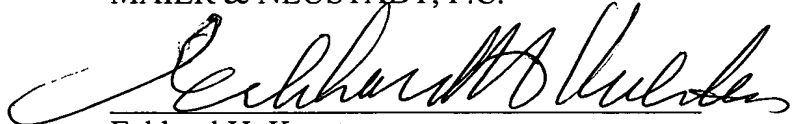
Claim 32 was rejected under 35 U.S.C. § 103(a) as obvious over Takahashi in view of Majumdar and Takahashi '159. That rejection is respectfully traversed.

The outstanding Office Action relies on Takahashi '159 for disclosing that a first material is identical to a second material. However, Takahashi '159 does not overcome the deficiencies of Takahashi and Majumdar discussed above. In addition, Claim 32 depends on independent Claim 1, which is believed to be allowable as discussed above. Accordingly, it is respectfully submitted that dependent Claim 32 is also allowable.

Consequently, in light of the above discussion the present application is believed to be in condition for allowance and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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A handwritten signature in black ink, appearing to read 'Eckhard H. Kuesters', written over a horizontal line.

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